MOTORIZATION PROCESS AND MANAGEMENT IN BIG CITIES IN CHINA

– Take Beijing as an Example –

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China is in a fast growing stage of urbanization and mobility development. The urbanization level of China increased from 36.09% in 2000 to 42.99% in 2005. The growth of vehicle numbers is also quite striking. It took almost half a century to reach the first one million vehicles in Beijing. Six and a half years passed before Beijing jumped to a city of two million vehicles, and 3.75 years later, on May 26th, 2007, Beijing confronted three million vehicles.

Urban sprawl and motorization in big cities causes social problems, such as traffic congestion, air and water pollution, energy problems, etc. This situation should be understood and taken into concern in the transportation policy.

This paper expresses and analyzes the mobility development process in big cities in China, taking Beijing as an example. The evolution of transportation policy is described. Both transportation demand management and infrastructure contraction should be considered simultaneously in the policy.

Key Words: Mobility development, Urbanization, Transportation policy, China

1. INTRODUCTION

1.1 The concept of mobility

In 1920, an American sociologist introduced the word *MOBILITY* to the sociology research, as one of the indexes for society equity measurement. Then European researchers introduced this word into the field of urban planning research. Cities' characteristics are described by both static urban layout and dynamic urban mobility with a transportation system. Urban transportation planning is no longer considered as subordinate in the urban planning process[1].

Modern urban planning theory has made great progress in recent years, while research on urban mobility is still in its early stages. With the development of cities, both in developed and developing countries, urban mobility is becoming a worldwide problem that is of concern.

1.2 Urban sprawl and mobility problems

The globally unprecedented scale of migration from rural to urban areas is anticipated to reach new records next year, when it is predicted that half of the world's population will live in cities[2]. This urbanization trend is occurring in both developing nations, like China, and in fully industrialized nations like the United States (Table 1). In many cases, economies and societies are changing faster than their physical infrastructure. Even cities that have advanced transit (including subway) systems, strict car-use restrictions, or relatively low populations of people and cars are suffering from traffic congestion. Thus, urban mobility has become a worldwide problem.

Traffic congestion causes many problems, the most obvious is vehicle speed reduction, which leads to time loss and fuel cost increase. Fuel in automobiles is fully burned when running with mid-speed (3/4 of the highest speed). But in congested traffic, automobiles stop and go continually, fuel is not fully burned and causes more air pollution. The most recent Texas Transportation Institute urban mobility report estimated that the direct loss (including human resource loss and fuel loss) caused by traffic congestion in the US is over 65 billion dollars[3]. This estimate does not include indirect losses, such as

Table 1 Urban sprawl in major cities

City	Population (10 thousand)			Area (km²)			Density (person/km²)		
	1980	1990	2000	1980	1990	2000	1980	1990	2000
Beijing	490	566	750	355	430	510	13,624	13,179	14,479
Shanghai	673	750	800	178	355	401	37,783	20,704	16,381
Hong Kong	499	552		171	194		33,045	29,174	29,427
New York	707	732	801	780	800	784	9,064	9,150	10,216
Los Angeles	297	349	369	1,204	1,215	1,214	2,467	2,872	3,040
Chicago	301	278	290	591	588	588	5,093	4,728	4,932

Source: U.S. Census and www.demographia.com

environmental pollution, lost investment, public health costs, and so on.

The World Bank estimates that traffic congestion alone causes a 1-3% loss in GDP in many countries, and possibly as much as twice that in developing countries[4]. In addition, air pollution from vehicles imposes a cost of up to 2% of GDP. Transportation accidents cause another 1-2% loss in GDP. Thus, the costs of congestion are externalities paid for not behind the wheel, but in public health and economic growth.

In Beijing, it is reported that the average vehicle speed decreased to 10kph in the daytime in 2006, which is lower than the average bike speed (12kph)[5]. Another study in Beijing found that 74% of hydrocarbons (HC), 63% of carbon monoxide (CO), and 46% of nitrogen oxides (NOx) in central Beijing air pollution and 85% of noise pollution are from motor vehicles[6].

1.3 Mobility development and research in China

Although many cities in China are suffering urban problems in the urbanization process, such as traffic congestion, housing pressure, air pollution etc, it is believed that future city mode will be gestated from China*. China has a totally different development track compared with occidental countries. Chinese cities are full of energy and original creation, so they are called "City labs"**.

This paper describes and analyzes the mobility development in these "City labs", and looking for the future urban mobility development mode in the world.

2. URBAN MOBILITY DEVELOPMENT IN CHINA

2.1 Mobility process and travel mode transformation

It is reported that the fastest growth stage in the urbanization process takes place when the GDP per capita is between 600 to 2000 dollars[7]. China is in this very stage. The urbanization level of China has increased from 36.09% in 2000 to 42.99% in 2005[8]. The average growth rate is 3.56% per year, which is about twice as larger as that of the world during the same time period.

With 18 million rural people rushing into cities every year[9], Chinese cities are expanding and the motorizing quickly. This paper takes Beijing, one of the metropolises in China, as an example to describe and analyze the characteristics of the motorization process in China.

2.2 Population move and urban transformation

The population of Beijing was 10.5 million in 2005, which is 24% larger than that in 2000. The city-wide area is expanding simultaneously, from 950.37 km² in 2000 to 1368.32 km² in 2005[10].

Although the population density of the central city is still much higher than that in the outer city, we should notice that more and more citizens move out of the central city to live because of social problems caused by high population density. Figure 1 shows the decrease of population density in the city center.

People still work in the central city but move to live in the outer city. This new work and living mode produces a large amount of tidal traffic flow.

2.3 Development of motor vehicle numbers

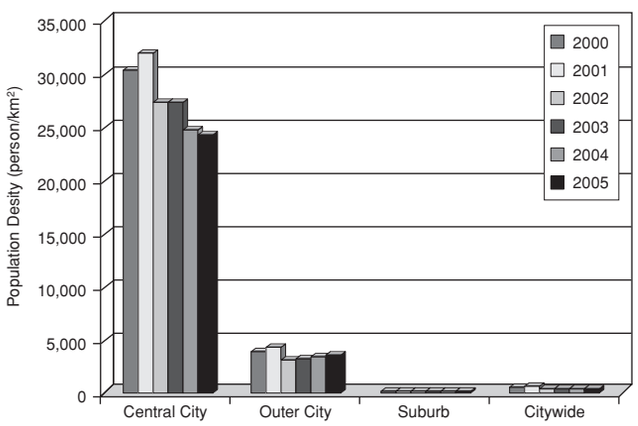
The growth of vehicle numbers is also quite striking. Government officials used to be the main users of cars for many years, but the situation is changing. It took almost half a century to reach the first million vehicles in Beijing, as shown in Figure 2. However, with rapid economic growth, Beijing has come into a fast motorization stage. According to international practice, most families become potential car users when GDP per capita exceeds 3000 dollars. And GDP per capita of Beijing was 3427 dollars in 2000, which means Beijing was welcoming its fast motorization stage. Six and a half years passed be-

* Stated by research from *Institute of City Movement in France* (IVM, short for *Institut pour la Ville en Mouvement*).

** Stated by IVM.

fore Beijing jumped to a city of two million vehicles, and 3.75 years later, on May 26th, 2007, Beijing confronted three million vehicles[10].

Compared with Hong Kong, the speed of vehicle growth in Beijing is much much faster (Fig. 1). The total number of vehicles in Beijing increased by 11% every year from 2000 to 2006, and most of the new vehicles are private cars (Fig. 2, Table 2). The motorization level in big cities in China, such as Beijing and Shanghai, is catching up with cities in developed countries (Fig. 3). Rapid growth of vehicle numbers brings a serious challenge to transportation infrastructure.



Source: Statistical Yearbook of Beijing, National Bureau of Statistics (2006)

Fig. 1 Population density of Beijing

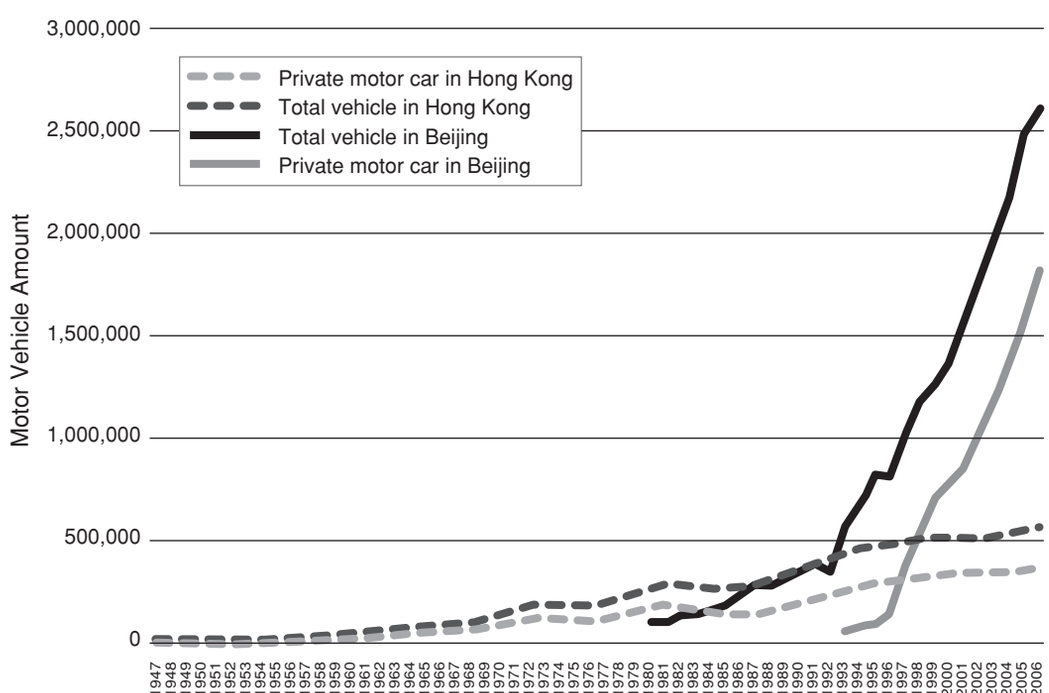
2.4 Trip purpose and frequency

With economic development, people travel more (Fig. 4) and longer (Trip length increases from 8 km in 2000 to 9.3 km in 2005). The proportion of travel for living, such as entertainment and shopping (Fig. 5), is increasing.

2.5 Modal split transformation

Although most citizens still choose non-motor travel mode, the proportion is decreasing. People are transferring to transit and car mode, as shown in Figure 6.

Car mode took the same proportion as transit mode in 2005, and shows a fast growth trend and will exceed transit mode in the future. A transportation investigation report of 2005, showed car travel had distinct advantages. Average travel length of car mode is 4.5 km longer than bus, but the average travel time was 24.3 minutes shorter; and car mode has the same average travel length as railways, but the average travel time is 36.3 minutes shorter.



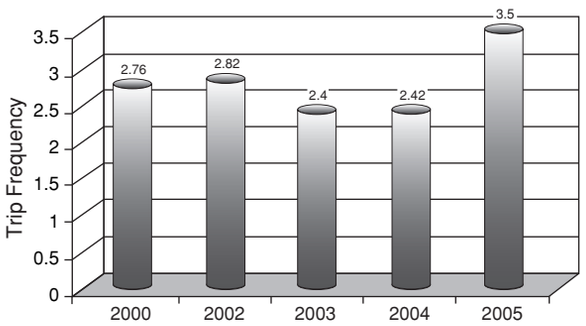
Source: China Statistical Yearbooks (2006)

Fig. 2 Motor vehicle numbers in Beijing and Hong Kong

Table 2 Vehicle numbers in Beijing

	Total	Private motor car
2000	136.5	76.2
2001	156.5	85.5
2002	176.5	100.5
2003	199.1	119.5
2004	216.7	138.9
2005	246.1	154.7
2006	258.3	179.8

Source: Statistical Yearbook of Beijing, National Bureau of Statistics (2006)



Source: Beijing Comprehensive Travel Investigation (2005)

Fig. 4 Trip frequency in Beijing

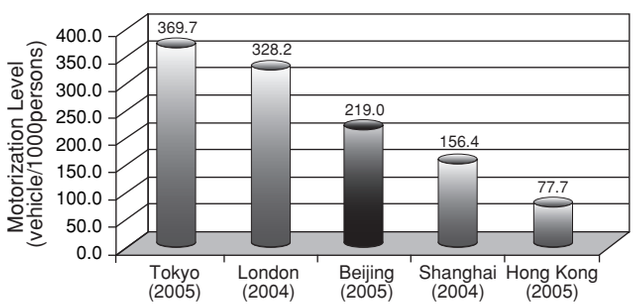
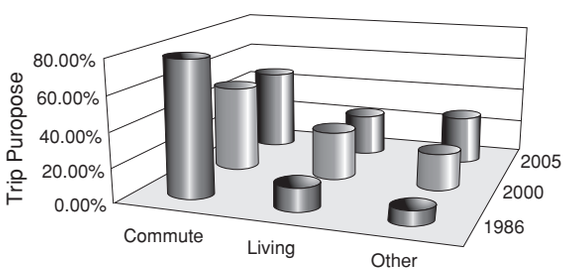


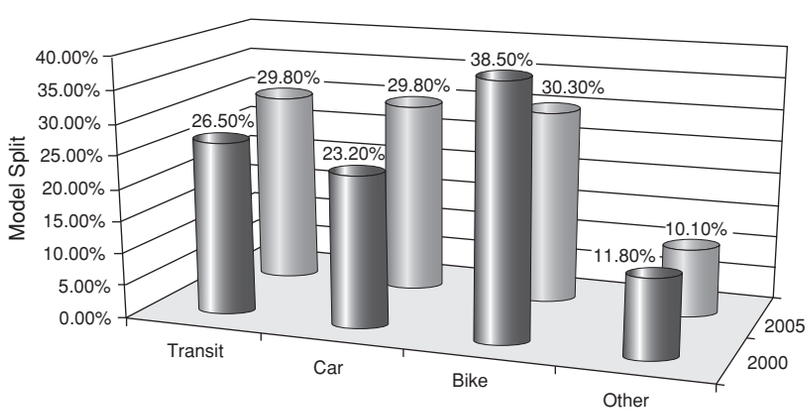
Fig. 3 Motorization level comparison



	Commute	Living	Other
1986	78.53%	13.71%	7.76%
2000	50.52%	28.67%	20.80%
2005	47.50%	24.30%	28.20%

Source: Beijing Comprehensive Travel Investigation (2005)

Fig. 5 Trip purpose in Beijing



Source: Beijing Comprehensive Travel Investigation (2005)

Fig. 6 Modal split in Beijing

3. TRANSPORTATION DEMAND MANAGEMENT

Transportation problems that are created out in the urban motorization development process reflect the imbalance between traffic demand and supply. To only increase supply will never solve the problems. Transportation demand management and infrastructure contraction should be considered simultaneously. Fortunately, more and more people agree on the TDM idea. Transportation policies in big cities in China, such as Beijing, have been introduced.

3.1 Transportation policy evolution

Victor Sit gives an excellent history of urban transportation planning in Beijing from 1949 - 1992[11]. This period saw the implementation of a socialist model for transport emphasizing minimization of the distance between home and work, heavy transit subsidy, and probicycle planning. However, Beijing suffered from problems common to many Third World cities, especially inadequate road infrastructure.

However, we argue that this is not the complete story of transportation policy in China. It is important to note that one major sign of the rapid evolution of transportation policy in China is increasing localization. It is no longer strictly accurate to speak of "Chinese policies," as cities such as Guangzhou, Shanghai, and Beijing have significantly diverged on key transportation policies. In the case of Beijing, while policies enabling motorization remain in place, many other improved transportation policies are being implemented. For example, land use and transportation planning are becoming more integrated, in response to uncertainty about the future[12]. The following section will describe some transportation-specific policies evolving in Beijing.

3.2 Focusing on railway construction

Prior to railway construction, the central government gave priority to research related to railway transportation[13]. Research projects have focused on key technologies, including transportation management systems for high-speed railways, vehicle manufacture, line construction, and system integration. The challenge for Beijing now is to apply this expertise to the system now under development.

The current transit system in Beijing is primarily composed of buses, and the investment shift represents an ambitious expansion of the subway and light rail elements of the system. Though part of the interest in expanding the Beijing rail system is driven by the upcoming Olympics, it also represents a national trend: 23 Chinese cities are currently expanding, constructing, or planning new subway lines. It should be pointed out that the bus system is not being replaced, but rather supplemented. Some policies relating to the bus system will be discussed in a later section. The railway system is intended to meet the vast demand that cannot be met by the bus system alone, especially over the greater trip distances between new town developments, suburban areas, and the city center[14].

3.3 Transportation demand management policy

TDM policies aim at changing people's ideas about traveling and changing people's travel behavior. A TDM strategy has been created for the upcoming Olympics that contain several policies that could be of great use in Beijing for the long term. During the Olympic events, some streets will be restricted so that private car access is forbidden, and many state-owned vehicles will not be allowed out at all. High-emission vehicles will be restricted. Flexible working time policies will be promoted for some companies, including working at home. In addition, to support the new infrastructure and capacity being added to the transit system, a major education campaign promoting public transit will be conducted leading up to the Games.

3.4 Parking policy

Legal parking is currently extremely scarce in Beijing, as is parking enforcement, and so illegal parking is rampant. As of early 2007, the number of vehicles in Beijing was 2.87 million, but parking supply fell short by approximately 1 million spaces. To mitigate this situation, both strategic parking infrastructure construction and pricing management can play a role in guiding auto use in the city. To this end, Beijing is currently planning the construction of terminal park-and-ride lots at the ring roads to enable drivers to use transit to access the city center. In addition, parking prices were reformed in Beijing in 2005 to increase the price of street and surface parking relative to underground parking, and to establish a rational price structure city-wide by place and time.

4. CONCLUSION

In the future, as household incomes continue to rise in Beijing, pressing concerns about congestion, environmental quality, and social equity mandate that public transport not become strictly the realm of the poor. China

is in its fast growing stage of urbanization and mobility development, which is chance and challenge. The situation should be understood and taken into concern in the transportation policy.

The major test of Beijing's transportation policy evolution will be how many changes driven by the Olympics can remain in place or in practice after the event. In the long term, greater integration with land use planning will also be crucial, for while the growth that has already occurred is truly impressive, it is sure that China's urbanization is not over yet.

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